Space Weather Technical Forecast

Issued on Monday, 30 October 2023 at 13:17 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of G1/Minor Storms on days 1 and 2 (30th/31st Oct). Chance of Active fluence from day 2 (31st Oct) onwards.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low, with the largest C-class flare from AR3474, peaking at C7.8 at 29/1309 UTC. This is one of three sunspot regions remaining on the visible disc. All three are of moderate complexity, being in Beta-Gamma formation, but AR3472 and AR3474 remain relatively small with only minor development of rudimentary penumbra. AR3474 however, in the southern central disc, has continued to grow and mature throughout the period and is now classified Dai/Beta-Gamma.
No Earth-directed CMEs have been observed in the available imagery during the period.

Solar Wind / Geomagnetic Activity: Solar wind speeds observed at L1 have remained elevated between 530 and 600km/s, but with a slight declining trend, as Earth remains under the influence of the high speed stream from coronal hole 66. Density was mostly below average (<5 ppcc). The total magnetic field strength was weak (<8 nT). The north-south component fluctuated weakly between -4 and + 4 nT. The Phi angle has remained predominantly positive (away from the Sun). Geomagnetic activity has been Quiet to Active (Kp 1-4).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels. GOES16 high energy (greater than 2MeV) electron flux was generally at moderate levels, but increased to High between 29/1520 UTC and 29/1920 UTC, with a peak 1890 pfu at 29/1610 UTC. The associated 24-hour fluence remains below the Active (1e8 integrated pfu) threshold but on a rising trend, peaking at 5.84e7 integrated pfu at 30/1200 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low solar activity is expected. There is a slight chance of isolated M-class flares and moderate activity, most likely from AR3474.

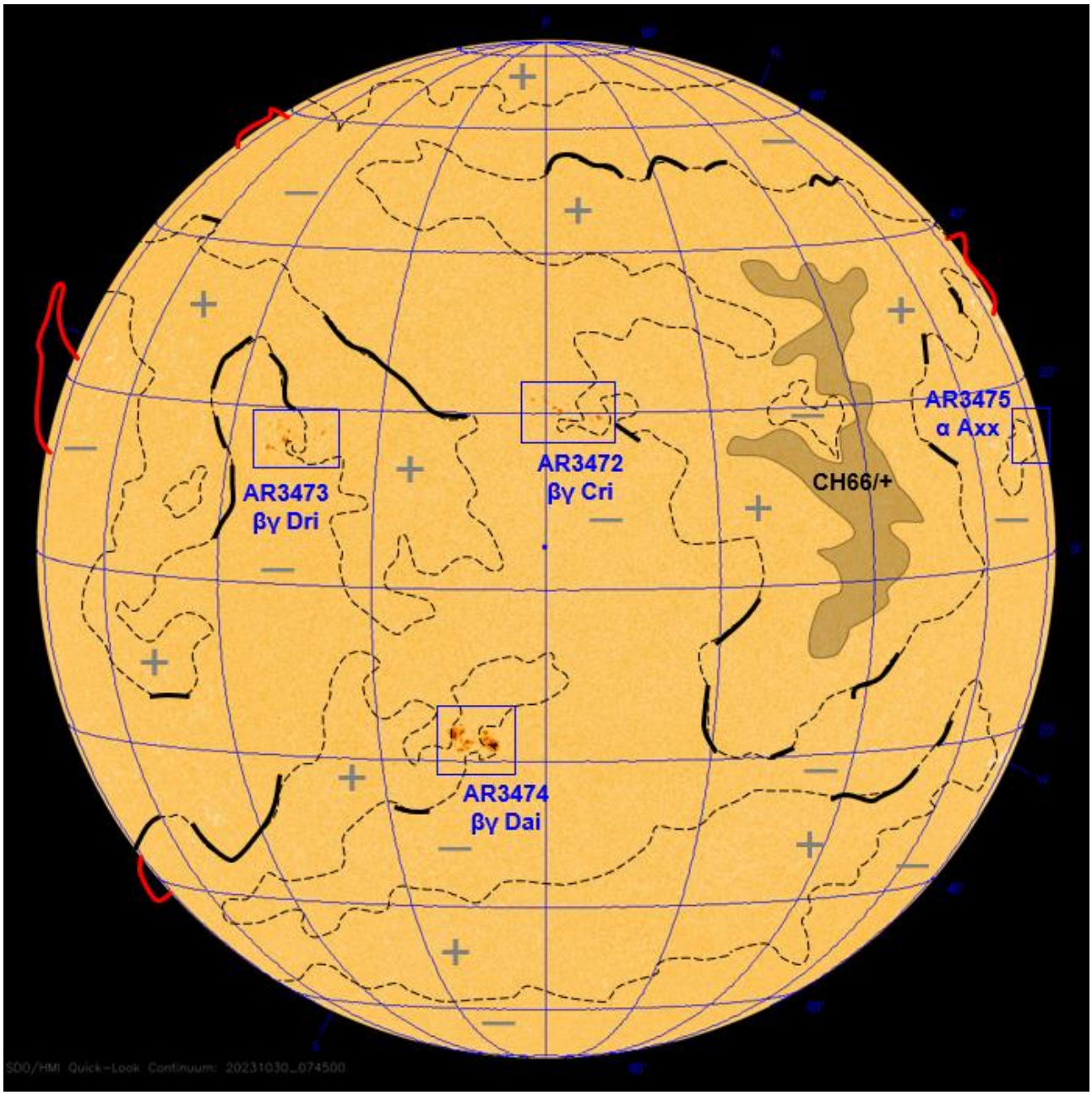
Solar Wind / Geomagnetic Activity: There are no Earth directed CMEs. The high speed stream from coronal hole 66 is currently connected to the Earth, giving solar wind speeds around 550 km/s. Speeds are expected to have peaked and should decline to ambient levels through the period. Unsettled to Active geomagnetic activity is expected to become increasingly Quiet throughout the period. There is a slight chance of isolated G1/Minor Geomagnetic Storm intervals on day 1 into day 2 (30th and 31st October).

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to persist at background. High energy electron flux (greater than 2MeV) is forecast to be at moderate to High levels. The associated 24 electron fluence is expected to see a rising trend, and is likely to reach Active levels (>1e8 integrated pfu) later in the period.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

Figure 1. Solar Analysis Valid 30/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

Geomagnetic Storms:

No Earth-directed CMEs are in the forecast.

Solar wind speeds are currently elevated, due to the high speed stream from positive coronal hole 66 in the western hemisphere. Speeds are currently around 550 km/s with a gradual decline towards ambient levels forecast by day 4 (2nd Nov).

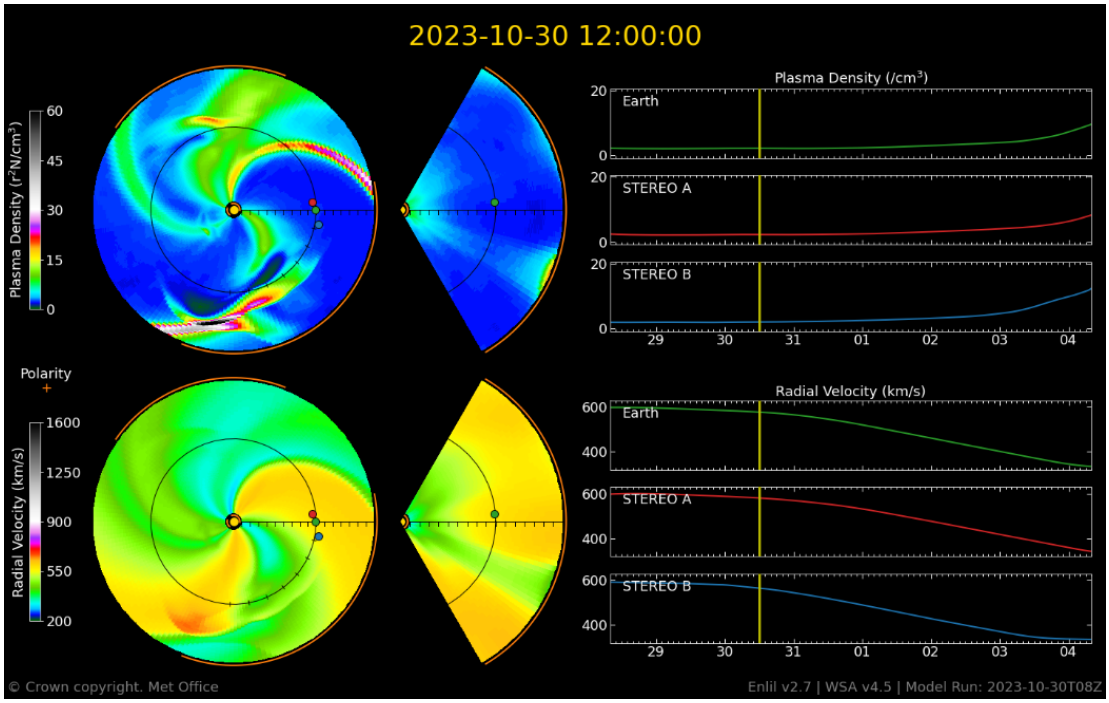
Unsettled to Active geomagnetic activity is expected to become increasingly Quiet throughout the period. There is a slight chance of isolated G1/Minor Geomagnetic Storm intervals early in the period if any sustained periods of negative Bz occur whilst solar wind speeds are still elevated.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Met Office Enlil model, offering good guidance of solar wind decline.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

Radio Blackouts - X-Ray Flares:

There are currently three sunspot regions of note on the visible disc. All of which are moderately complex, being in Beta-Gamma formation, but only AR3474 (Dai/Beta-Gamma) in the southern central disc is of significant size and maturity. A couple of potentially noteworthy sunspots have been detected by far sided products, and may rotate onto the visible side from around 01 November.

Low solar activity is forecast for the period, but there is a slight chance of this increasing to Moderate levels at times, with isolated M-class flares. This risk perhaps increases later in the period with the possibility of further sunspots appearing round the eastern limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	20	25	30
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is expected to persist at background levels in the absence of significant sunspot regions within the western hemisphere of the visible disc.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	2	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

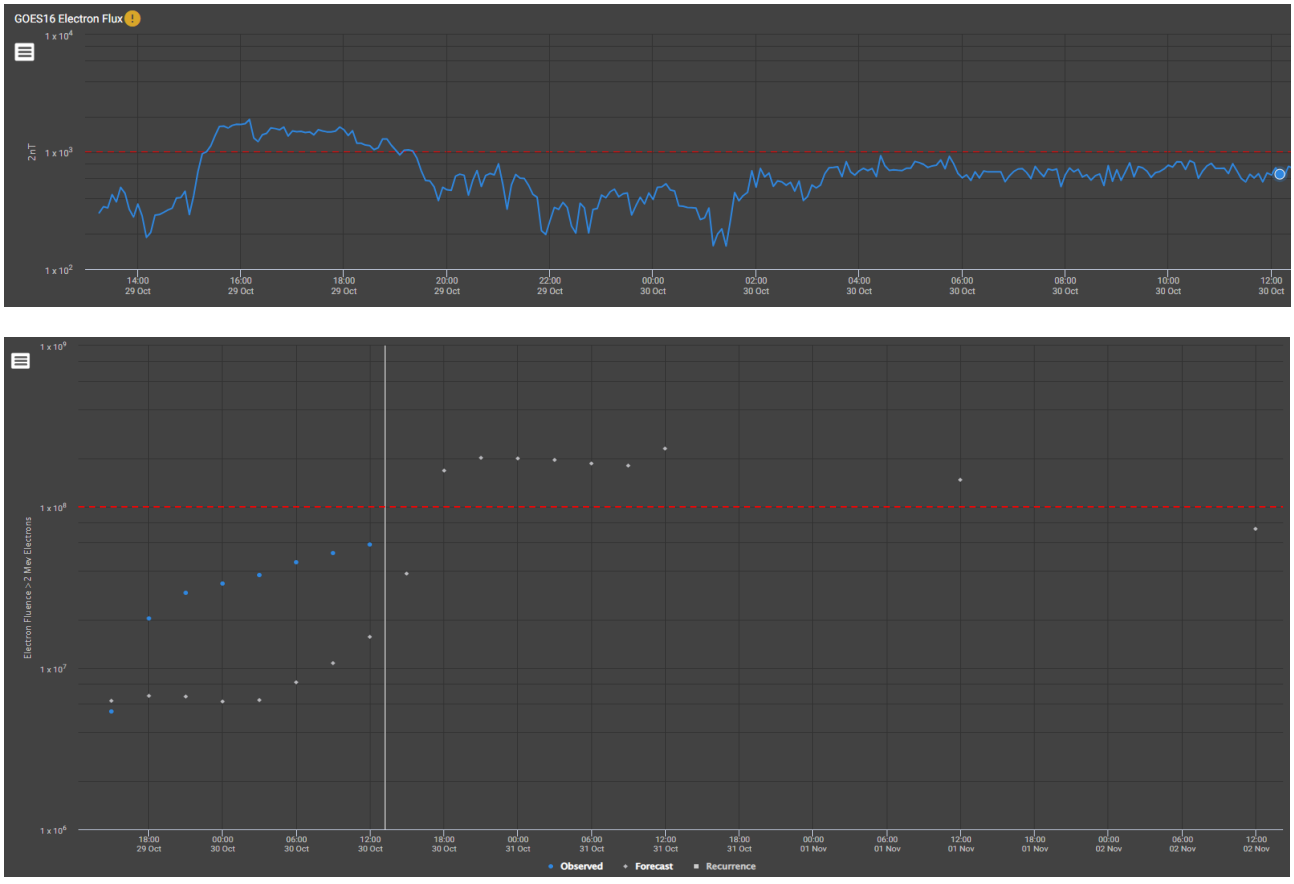
© Crown Copyright 2023. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux has begun to rise in response to the high speed stream from coronal hole 66 and the subsequent increase in electron populations in the radiation belts. There is an increasing chance of reaching the high threshold during diurnal maximums through the period as geomagnetic activity eases. However, the solar wind pressure as a result of the strong speeds may distort the belts, with a sharp increase possible by day 2 and 3 (31 October and 01 November) as the speeds decline further.
24-hour electron fluence is forecast to follow a rising trend through the next four days, with the Active threshold likely to be reached by day 3 (01 Nov). REFM is beginning to indicate a response to the solar wind enhancements and is offering good guidance.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	30	50	60	60
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: GOES-16 observed electron flux and fluence, plus REFM forecast fluence data.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.